Technical Specifications for DAS expansion

IT Facilities Requirements

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1. Hardware Requirements

It is the Employer's intent to procure the hardware that is fully compliant to the Upgraded DAS system. During the design phase, an alternative configuration may arise in addressing the requirements fully. This alternative configuration shall be developed in full consultation with the Employer, and this shall not relieve the Contractor from the functional, availability, performance, capacity, and other requirements of these Technical Specifications.

1.1 General Requirements

All hardware shall be manufactured, fabricated, assembled, finished, and documented with workmanship of the highest production quality and shall conform to all applicable quality control standards of the original manufacturer and the Contractor. All hardware components shall be new and suitable for the purposes specified.

Hardware delivered by the contractor will be housed in various floors of BESCOM Integrated Control Center-1, HSR Layout, Bengaluru. Hardware will be connected to the servers and networking equipment housed in BESCOM Data Center located in Ground Floor of BESCOM Integrated Control Center-1, HSR Layout, Bengaluru. The workstations and video project system will be connected to the SCADA LAN/OD LAN of the Upgraded DAS system through redundant L2-16 port managed switches that supports Gigabit Ethernet ports with SFP. The contractor is responsible for supply, installation, mounting, electrical cabling from BESCOM's No break supply system, redundant network cabling from BESCOM data center to the workstation location, labelling and securing the hardware delivered in its scope.

All hardware features offered by the Contractor shall be fully supported by the System.

1.2 Security of Access

Hardware utilising any release of the Windows™ Operating System shall be configured to utilise profiling or Group Policy under administrator control to ensure that security of access to the System is maintained at the highest level. The profiling as a minimum shall be configured to support at least two (2) modes of access, i.e., operations and maintenance. The operations profile shall disable all devices that would allow access to any hardware resources such as removable media, USB ports, and DVD drives. The operations profile shall disable user privileges that would allow the installing of software and the running of software not required as part of the System configuration. Access to the maintenance profile shall be restricted to Login using a Password or Two Factor Authentication. The final arrangement of profiles and their associated constraints shall be determined during the design phase and is subject to the Employer's approval.

1.3 Network Management Support

All hardware devices delivered by the contractor shall incorporate and support SNMP capability for the management and monitoring of the devices in Network Monitoring System.

1.4 LAN Hardware Requirements

LANs in the System shall be designed to carry High Speed Data up to 1,000 Mbps and all connections (wiring, connectors, patch cables, jacks, plugs, and installation techniques, etc.) shall be in accordance with ISO/IEC 11801. Fire retardant plenum Ethernet cable shall be used for establishing the LAN. Cable colouring shall differentiate the redundant LANs.

Where redundant LANs are required, each LAN shall be implemented with separate switch. Contractor provided switch should be at minimum, Layer 2 16-port Managed Switches. In addition to the "store and forward" features of common unmanaged switches, managed switches also incorporate

capability such as SNMP, RSTP, IGMP, and VLAN. Cable colouring shall differentiate the redundant LANs.

On-line reconfiguration and enhancement of network hardware and software shall be supported via password-protected administrative interface.

1.5 Operational Department LAN

OD LAN includes the local networks at BICC-1. The OD LAN shall have the same specifications as the SCADA LAN. Workstations with single monitor display mentioned in the BOQ shall be connected to OD LAN. Cabling and all associated works that are required to connect the workstations to OD LAN shall be carried out by the contractor.

1.6 SCADA LAN

SCADA LAN is part of the militarized zone of DAS system. Workstations with dual monitor display mentioned in the BOQ shall be connected to SCADA LAN. Cabling and all associated works that are required to connect the workstations to SCADA LAN shall be carried out by the contractor.

1.7 Workstations

Contractor shall deliver three types of workstations as below,

1. Outage Operator workstations with dual monitors

   These workstations shall be used for monitoring the distribution network and will be connected to the SCADA LAN. In order to maintain uniformity and compatibility with SCADA software, the contractor shall deliver workstations of the same configuration and compatible to the system delivered under “Upgradation of DAS in Bengaluru City Project”.

   The minimum technical specification of these workstations is as defined below.

   - Dell Precision 5820XL Tower XCTO Bas or equivalent

- Intel Xeon Processor W-2223 (4C 3.6GHz 3.9 GHZ Turbo HT 8.25MB 120W DDR4-2666)
- NVIDIA RTX A 2000 12GB 4mDP to DP
- Integrated Intel AHCI SATA Chipset controller (8x 6.0Gb/s) SW RAID 0,1,5,10
- 64GB 4x16GB DDR4 2933MHz RDIMM ECC Memory
- 500GB SATA 7200 RPM Hard disk
- Dual Gigabit NIC card (PCIe Intel) SFP compatible
- Dell 24'' monitor- 2Nos
- Keyboard and Mouse, Mouse pad
- Sound card and speakers
- Onsite/In-home service after remote diagnosis for five years
- Windows 11 Pro for workstation (up to 4 cores), English

The following licensed software applications shall be installed on the PC with a subscription period of at least 5 years from the date of commencement of warranty period:

a) Windows 11 Pro for workstation
b) Antivirus (Shall be of the same make as that of SCADA system. This will be informed during design stage)
c) PDF Viewer.
d) File Archiver.

2. Operational Department Interface Workstations with single monitor.

These workstations shall be connected to OD LAN. In order to maintain uniformity and compatibility, the contractor shall deliver workstations of the same configuration and compatible to the system delivered under “Upgradation of DAS in Bengaluru City Project”.

The minimum technical specification of these workstations is as defined below.

- Dell Precision 5820XL Tower XCTO Bas or equivalent

- Intel Xeon Processor W-2223 (4C 3.6GHz 3.9 GHZ Turbo HT 8.25MB 120W DDR4-2666)
- NVIDIA RTX A 2000 12GB 4mDP to DP
- Integrated Intel AHCI SATA Chipset controller (8x 6.0Gb/s) SW RAID 0,1,5,10
- 64GB 4x16GB DDR4 2933MHz RDIMM ECC Memory
- 512GB SSD Hard Drive
- Dual Gigabit NIC card (PCIe Intel) SFP compatible
- Dell 24'' monitor
- Keyboard and Mouse, Mouse pad
- Sound card and speakers
- Onsite/In-home service after remote diagnosis for five years
- Windows 11 Pro for workstation (up to 4 cores), English

The following licensed software applications shall be installed on the PC with a subscription period of at least 5 years from the date of commencement of warranty period:

a) Windows 11 Pro for workstation
b) Antivirus (Shall be of the same make as that of SCADA system. This will be informed during design stage)
c) PDF Viewer.
d) File Archiver.

3. Remote VDUs at Zonal and Circle offices

The contractor shall deliver and install these visual display units or workstations at designated BESCOM's Zonal and Circle Offices located in Davanagere, Chitradurga, Tumkur, Chikkaballapura, Bengaluru Rural limits, etc. The final office locations will be intimated during implementation phase. These workstations will be used by BESCOM Management (non-system users) for monitoring their distribution network or running reports pertaining to their jurisdiction.

Contractor shall deliver firewall/SD-WAN devices at each of these remote office locations and establish communication from BESCOM Data center to these firewalls, to enable the Non-system users to access DAS data pertaining to their jurisdiction.

In order to maintain uniformity and compatibility, the contractor shall deliver workstations of the same configuration and compatible to the system delivered under "Upgradation of DAS in Bengaluru City Project".

The minimum technical specification of these workstations is as defined below.

- Dell Precision 5820XL Tower XCTO Bas or equivalent
- Intel Xeon Processor W-2223 (4C 3.6GHz 3.9 GHZ Turbo HT 8.25MB 120W DDR4-2666)
- NVIDIA RTX A 2000 12GB 4mDP to DP
- Integrated Intel AHCI SATA Chipset controller (8x 6.0Gb/s) SW RAID 0,1,5,10
- 64GB 4x16GB DDR4 2933MHz RDIMM ECC Memory
- 512GB SSD Hard Drive
- Dual Gigabit NIC card (PCIe Intel) SFP compatible
- Dell 24'' monitor
- Keyboard and Mouse, Mouse pad
- Sound card and speakers
- Onsite/In-home service after remote diagnosis for five years
- Windows 11 Pro for workstation (up to 4 cores), English

The following licensed software applications shall be installed on the PC with a subscription period of at least 5 years from the date of commencement of warranty period:

a) Windows 11 Pro for workstation

b) Antivirus (Shall be of the same make as that of SCADA system. This will be informed during design stage)
c) PDF Viewer.
d) File Archiver.

All consoles shall include facilities to detect the loss of input power, execute an orderly shutdown upon loss of input power, and automatically resume operation when power is restored.

1.8 Monitors

Each monitor shall have the following minimum characteristics; however, contractor shall deliver monitors that conform to the latest technology and are compatible with the workstations delivered in this contract:

1) Minimum screen diagonal measurement of 609 mm [twenty four (24) inches] with a minimum viewable area of 584 mm [twenty (23) inches].
2) Support for multiple screen resolutions, with best display characteristics at least 1920 by 1200 pixels (minimum).
3) Horizontal synchronisation rate of 31 kHz to 80 kHz and vertical synchronisation rate of 55 Hz to 75 Hz.
4) Automatic detection of and switching to all resolutions and refresh rates.
5) Screen surface shall be abrasion resistant and incorporate glare reduction features such as tinted, anti-glare screen coatings.
6) Minimum viewing angles of 160^{o} or better (horizontal and vertical).
7) Minimum brightness of 300 cd/m^2.
8) Minimum contrast ratio of 1000:1.
9) Colour depth of 16.7 million.
10) Pixel response time of 8 ms or less.
11) Video inputs: Digital using DVI-D connectors.
12) On-screen menu operation for control of video tuning.

The monitors shall be supplied with tilt and swivel bases, including a mounting plate for desktop stand. The tilt range shall be from a minimum of five (5) degrees downward (measured from a plane perpendicular to the face of the screen) to thirty (30) degrees upward. The monitor base shall have a swivel range of ± 30 degrees from a nominal centered position. The monitor support bases shall have a height adjustment range of 3.5" from the lowest to highest position. The monitor bezel shall be a thin-edge design with a bezel thickness of 20mm maximum.

The monitors shall be designed for 24 hours per day, 7 days per week, continuous operation. Nominal backlight life under these conditions shall be 50,000 hours. The monitors shall be capable of operating within a temperature range of 5 to 38 degrees C, and humidity levels of up to a maximum of 80%. Power requirements shall be 230 VAC (+5% and -10%) at 50 Hz.

1.9 Keyboard and Cursor Control

One keyboard shall be provided at each console. The keyboard shall include an alphanumeric keyboard, numeric keyboard, four-key cursor control, and a minimum of twelve (12) function keys.

The cursor control device shall be an optical mouse. One device shall be provided at each console. The device shall facilitate movement of the displayed cursor in any direction and at varying speeds without the use of function keyboard controls.

The keyboard and cursor control device shall be shared among all monitors at each console. The cursor control device shall move across all monitors without switching by the user. Keyboard output shall be directed to the active window (as determined by the user interface techniques).

1.10 Audible Alarm

Each console shall be equipped with an audible alarm tone generator. Tone volume shall be linearly adjustable by the user from inaudible (off) to full maximum output [ninety (90) dbA minimum] at one (1) metre from the console.

1.11 Video Projection System

Contractor must deliver and integrate DAS system to a video projection system for projecting the SCADA / System displays on demand to the VPS. This video projection system will be part of the SCADA LAN of DAS system.

The VPS integration shall allow the Operators and other Employer personnel to present displays in various configurations. This shall include, for example, the presentation of a single display across all screens or several different displays on individually selected screens.

A single summary display shall always be configured at the corner of VPS to be projected from one of the console representing the real-time SCADA summary information (whose template will be shared by the Employer during implementation stage).

The VPS shall include an indoor active LED screen and video wall processor of the same OEM of reputed brands like Daktronics / Delta / Mitsubishi/ NEC/ equivalent. The minimum technical specification is as below.

- Indoor active LED Wall

Parameter	**Specifications**
Display Size	3.6 M x 2.025 M
Pixel Pitch	0.9375 mm or better
Pixel Configuration	1R1G1B
LED Technology	COB(Chip On Board)
Pixel Density	11,37,778 pixels/m2 or better
Brightness	800 cd/m2 or better
Dimming Capability	0-255 Levels or higher
Contrast Ratio	20000:1 or better

Refresh Rate	3840 Hz or better
Color Processing	14-bit or better
Colors	4.4 Trillion
Viewing Angle	H: 170° or better, V: 170° or better
Lifetime	100,000 hrs or better
Power Input	AC 100V-240V
Max. Power Consumption	80 (W/Cabinet)
Operating Temperature	-10° ~ 45°C
Operating Humidity	10%~90%RH
Service Access	Front
Cabinet Depth	40 mm or lower
Control Port	RJ 45/USB
Input Resolution	Full HD or better
Output	RJ45
Maximum Load Capacity	As per requirement
Input Voltage	100~240 VAC
Operating Temperature	5~40 Deg C
Switching	Seamless switching & scaling , fade in/ fade out, PIP function support size & location
Mechanical Structure For Mounting Of LED screen	

- **Video Wall Processor**

  Video Wall Processor should be able to make complete LED wall behave as one logical area. It should be possible to display any or all the inputs on the video wall in any desired configuration.

Parameter	**Specifications**
Controller	Video Wall Processor and management software should be from same OEM as of the LED Video Wall
Architecture	Server architecture

Operating System	Windows 11 Pro or higher- 64 bit
RAM	64 GB or higher
SSD	1TB or higher
RAID	RAID 0 should be provided with two hard drives
Chip	Intel i7 or better
Power Supply	Dual Redundant Power Supply
Outputs	4 HDMI Outputs
Inputs	8 HDMI Inputs & Dual LAN Ports
Chassis	19" rack mount industrial chassis
Controller certification	Controller should have BIS certification
Wall management Software	
Scaling and display	Software to enable the user to display multiple sources in any size and anywhere on the display wall.
Auto Source Detection	Software should support for auto source detection
Layout Management	Should support for Video, RGB, DVI, Web browser, Desktop Application and Remote Desktop or VNC Monitoring Layouts
Scenarios	Software should able to Save and Load desktop layouts from Local or remote machines
Layout Preview	Software should support layout preview option
Integration with 3rd party devices	System should offer interface to enable control from SCADA system
User friendly	Software should be user friendly
Protection	System should have Hardware License key to protect the software from unauthorized access.
Snap sensitivity	Enables the magnetic behaviour to fit the sources automatically for easy alignment on the wall
Scalable GUI	Scalable GUI to scale to any size of Video wall screen.

The contractor shall provide networking cable, Keyboard, mouse and mouse pad to configure the video wall by accessing the processor.

1.12 Printers

Contractor shall deliver printers as per technical specification below.

- Color multifunction printers (2Nos) supporting A3 and A4 sizes with five year support - 20ppm, 4GB, 128gb ssd, 500 sheets x 1 tray, 100 sheets bypass, 10.1" LCD touch, trolley, Wi-Fi and LAN compatibility and Duplex
- Black and White multifunction printers (2Nos) supporting A3 and A4 with five year support - 20ppm, 4GB, 128gb ssd, 500 sheets x 1 tray, 100 sheets bypass, 10.1" LCD touch, trolley, Wi-Fi and LAN compatibility and Duplex

Printers shall be interfaced with the SCADA LAN. All consoles shall be configured with at least one black and white and a colour printer within the same LAN at all times and shall support printing without the need for any additional configuration by the system user. The contractor shall be responsible for maintenance of all the printers during the contract period including warranty period.

1.13 SMS Gateway

The contractor shall deliver and configure redundant SMS gateway hardware, software and integrate it with DAS control centers to send outage notification of O&M field officers. SMS gateway shall adhere to all cyber security policies and shall support atleast 20,000 numbers SMS per month. This capacity shall be finalized in consultation with the Employer during design stage based on the number of outages generated in the system, at no additional cost to BESCOM. Contractor shall subscribe for SMS services and maintenance support for a period of five years.

1.14 Time, day & date digital display

Contractor shall deliver a time, date and day digital display for projecting the SCADA time, date and day near the workstation area. The displayed time and date shall be visible from a distance of atleast 10meters.

1.15 DAC Simulators

DAC simulators shall consist of laptops capable of allowing users to conduct the equivalent of DAS point-to-point testing of SCADA devices installed across BESCOM jurisdiction, as each of these devices becomes available for "SCADA ready" testing on a local site-by-site basis.

Each DAC simulator shall include at least two communication ports and all necessary interface connectors and cables to allow direct on-site connection of the simulator to the two communication ports to be provided with each type of field device interface (one for normal DAS operations, the other for field device interface diagnostics). As a minimum, the DAC simulator shall support the contracted protocols and FTP.

PC shall represent the latest notebook technology available. The keyboard capabilities and features shall be specifically selected to ensure that it is entirely suited to its intended use. It shall be delivered with a case sufficiently sized to contain and safely protect all of its components. Both the notebook PC and case shall be sufficiently rugged to withstand frequent transportation and use under typical field conditions.

In order to maintain uniformity and compatibility, the contractor shall DAC Simulators of the same configuration and compatible with the system delivered under "Upgradation of DAS in Bengaluru City Project".

The minimum technical specification of DAC simulators is as defined below

- Dell Make - Intel i7 Processor
- 64GB RAM
- Minimum 15.4'' display
- Windows latest OS with five year support
- Hard disk 1TB
- Required Graphic Controller Hardware

- Network 10/100, IEEE 802.11 b/g (Wi-Fi)
- 2 serial ports, 4 USB 3.0 or higher ports at least
- HDMI support
- Keyboard suitable for intended use
- Battery Li-Ion type, high capacity
- Wireless Mouse and its accessories

The following licensed software applications shall be installed on the PC with a subscription period of at least 5 years from the date of commencement of warranty period:

a) Windows 11 Pro or later OS
b) Antivirus (Shall be of the same make as that of SCADA system. This will be informed during design stage)
c) PDF Viewer.
d) File Archiver.

1.16 Firewall/SD-WAN device at Remote VDU location

- Contractor shall provide one SD-WAN device at each Remote VDU Location and establish communication link from the SD-WAN device to BESCOM data center. The SD-WAN device shall be configured by the contractor to allow specific data exchange between Control centre and Remote VDU Console. Air conditioning facility may be unavailable at Remote VDU locations, hence the SD-WAN device is required to operate satisfactorily and continuously in high temperatures.
- SD-WAN device shall support point to point and point to multipoint communication with both master and slave mode operations.
- SD-WAN device shall comply with IP55 degree of protection.
- Contractor shall provide terminal software/interface and adequate port for configuration and diagnosis.
- SD-WAN device shall support hardware & software WDT (Watchdog Timer). It shall have facility to auto reboot over disconnection with remote server up to certain defined time.

- SD-WAN device shall have 02 No. of Ethernet LAN with 10/100 Mbps RJ45 port. It shall support MPLS, MVPN, IPSec and Open VPN Network connectivity for establishing connection between Control centre and Remote VDU Console. SD-WAN device shall have atleast one number of WAN port with SFP for establishing communication link with Control centre.
- SD-WAN device shall be configurable through Local as well as remote server via Web UI or other configuration software. It shall support NAT table routing and TCP, UDP, ICMP, SNMP, NAT, DMZ protocols.
- It shall be designed and constructed in such a way to avoid introducing any danger in use and under normal conditions so as to ensure specially
    1. Personnel safety against electric shock.
    2. Personnel safety against effects of excessive temperature.
    3. Protection against spread of fire.
    4. Protection against penetration of solid objects, dust and water
- It shall be capable to withstand surges and voltage spikes by providing necessary isolation and / or suppression system built in the system. External surge protection device also to be provided.
- All other communications should be blocked other than data exchange from Control centre and Remote VDU Console.
- For determining health of the device an LED shall be provided which will depict the current functioning status (power on / transmitting data).

1.17 Operating and Construction Requirements

All System equipment shall operate and be constructed in accordance with the following requirements and shall be in full compliance of all applicable electrical wiring standards of India.

1.17.1 Cabling General

Contractor is solely responsible for the supply and installation of cables and interconnections to the designated interface points of supplied equipment. In the absence of such a definition, this shall include any additional cabling at no additional cost to the Employer, to ensure that the delivered hardware are connected to DAS system and are operational.

All cabling shall as a minimum be installed in conformance with electrical wiring standards applicable in India and unless otherwise stated shall be rated to handle overloads of 100%.

Contractor must deliver cabinets to mount the switches, firewalls, SD-WAN devices, CPU's of workstations, video wall processor, video wall along with power supply sockets. Additional power sockets shall be provided near each workstation for personal use of operators.

The contractor shall study the existing facilities at the Employer's site and design the cabling layout in co-ordination with the Employer.

1.17.2 Power Distribution and Protection

Contractor shall connect each power supply module of equipment's to different dual power circuits. Power circuits shall be drawn or laid by from the No break Supply system located in Ground Floor of BICC-1, HSR Layout, Bengaluru or any distribution or sub-distribution board indicated by Employer during implementation phase.

Power circuits shall be drawn by the contractor in such a way that, RPS unit of each equipment, except workstations will be connected to different power circuit to fully utilise the redundancy in hardware, maximise diversity of supply, and remove common failure modes for any redundant hardware. Contractor shall study, design and place the equipment in such a way that it does not overload the circuit's sizing/capacity.

Contractor shall assess, supply and install all fusing, circuit breakers, switches and surge protection necessary to protect the hardware. Contractor shall be responsible for maintenance of all components during the contract period and warranty period for five years.

1.17.3 Enclosures

Except for consoles, monitors, keyboards, cursor positioning devices, printers, and processor terminals, all equipment shall be mounted in the enclosures and adhere to the below requirements

1) Wiring within enclosures shall be neatly arranged and securely fastened to the enclosure by non-conductive fasteners. Wiring between all stationary and moveable components, such as wiring across hinges or to components mounted on extension slides, shall allow for full movement of the component without binding or chafing of the wire.
1) All materials used in the enclosures including cable insulation or sheathing, wire troughs, terminal blocks, and enclosure trim shall be made of flame retardant material and shall not produce toxic gasses under fire conditions.
2) Enclosures shall support both top and bottom cable entry. Adequate space and hardware shall be provided for routing of the cables within the Enclosures. Preformed cables shall be constructed so that a clamp holds the overall sheath of the cable, which shall be an integral part of the plug or socket. All cables or preformed cables within the enclosures shall have adequate support at regular intervals to prevent any stress on the plug or socket, and to promote a neat appearance.
3) All cables and wiring shall be appropriately labelled. The labelling shall be subject to approval of the Employer. The plug and socket at either end of any preformed cable shall be specifically identified to minimise incorrect cable connection.
4) All cables passing under the raised floor shall be rated as National Electrical Code (NEC) Class 2 Plenum cable. Cables shall be tested to NFPA 262-1985 Test for Fire and Smoke Characteristics of Wires and Cables to a maximum peak optical

density of 0.5, a maximum average optical density of 0.15, and a maximum allowable flame travel distance of 1.5 metres.

5) All enclosures shall have ventilation openings in the doors, which shall be screened with vermin proof fine brass gauze and a suitable filter and arranged to minimise entry of dust and prevent entry of water.
6) The Contractor shall use the KRONE™ cable/wire termination system for the terminating and organising of all telephone grade cabling. The Contractor shall supply small distribution frames within respective enclosures for the termination of communications cables and jumpering to the communication system. Surge arrestors shall protect these cables.
7) Detachable gland plates or channel pieces of sufficient size and number shall be provided for either top or bottom cable entry or both. Gland plates for single core cables shall be of non-ferrous material. Floor mounted indoor cubicles may have their bottom entry gland plates substituted by channel mounted cable clamps for cable support. Where channel mounted clamps are provided for cable support alternative methods for prevention of vermin entry, and spread of fire or smoke shall be provided.
8) Cooling air shall be drawn from the conditioned air within the room. Cooling air shall not be ducted or directed to the enclosures.
9) Wherever operating voltages within the enclosures exceed 50 volts AC or there is DC supply, the hardware shall be covered or shielded from accidental contact and shall be labelled accordingly.
10) All enclosures that are powered from 230 VAC shall include four (4) 230 VAC convenience outlets at the bottom of the enclosure.

1.17.4 Enclosure Grounding

The contractor shall provide enclosure grounding facility as deemed necessary to deliver the required performance of the system, subject to the Employer's approval.

1.17.5 Interconnections

Contractor shall supply all cabling between component units of the System within each facility. Plug-type connectors with captive fasteners shall be used for all signal interconnections. The connectors shall be polarised to prevent improper assembly. Each end of each interconnection cable shall be marked with the cable number and the identifying number and location of each of the cable's terminations. Each cable shall be continuous between components; no intermediate splices or connectors shall be used. Terminations shall be entirely within the enclosures. All interconnection cabling and connectors shall comply with latest ISO/IEC Standards.

Employer proposes to host the delivered hardware including workstations, video wall and one pair of L2 – 16 port switches at first or second floor of BICC-1, HSR Layout, Bengaluru. These hardware shall be connected to SCADA LAN or OD LAN of DAS system via the second pair of L2 – 16 port switches that shall be delivered by the contractor. The contractor shall supply and lay redundant OFC from first or second floor of BICC-1, HSR Layout, Bengaluru to connect to DAS system housed in BESCOM's data center at Ground floor of BICC-1, HSR Layout, Bengaluru. These OFC will terminate at two L2-switches delivered by the contractor to first or second floor of BICC-1, HSR Layout, Bengaluru. From these L2-switches redundant Ethernet cables shall be drawn to the workstations, video wall, etc. To support the cabling including power distribution and communications, the contractor shall make any perforations in walls or floors to allow cables to pass. All works shall be executed in a clean way and the area shall be cleaned regularly to remove all debris. Safety standards shall be adhered by all contractor's personnel during work execution.

Contractor is responsible for supplying and carrying out necessary cabling and providing any cable trays and hardware as necessary.

Contractor shall submit design drawing depicting the placement of all hardware and their interconnection to BESCOM data center in consultation with the Employer. Employer will review and approve these design drawings. Contractor shall submit as-built drawings after work execution for Employer's reference.

1.18 Application Licenses

The contractor shall in consultation with the Employer procure software license, if any from the OEM of upgraded DAS system, as required during integration of delivered hardware to DAS.

2. Design document and drawing submission

2.1 The Contractor shall prepare and submit the basic and detailed design in compliance with the provisions of the Contract, or where not so specified, in accordance with good engineering practice.

2.2 The Contractor shall be responsible for any discrepancies, errors or omissions in the specifications, drawings and other technical documents that it has prepared, whether such specifications, drawings and other documents have been approved by the Employer's Representative or not, provided that such discrepancies, errors or omissions are not because of inaccurate information furnished in writing to the Contractor by or on behalf of the Employer.

2.3 Codes and Standards : Wherever references are made in the Contract to codes and standards in accordance with which the Contract shall be executed, the edition or the revised version of such codes and standards current at the date twenty-eight (28) days prior to date of bid submission shall apply unless otherwise specified. During

Contract execution, any changes in such codes and standards shall be applied after approval by the Employer.

2.4 Approval/Review of Technical Documents by Employer's Representative: The Contractor shall prepare and furnish to the Employer's Representative the design documents including but not limited to technical specifications as per tender, compliance to technical specifications, power and facility requirements, erection plan of action, cabling layout, etc for its approval or review. Any part of the Facilities covered by or related to the documents to be approved by the Employer's Representative shall be executed only after the Employer's Representative's approval thereof. Unless otherwise specified in the Technical Specifications, the design documents shall be submitted within two months of the date of issue of DWA.

3. Hardware inspection and delivery

3.1 Contractor shall manufacture or procure the hardware as per approved design document. Contractor shall submit standard Factory acceptance test procedures for Employer review and approval. Contractor shall then submit inspection request to the Employer.

3.2 Hardware will be inspected at the contractor's site by two to three numbers of officers deputed by BESCOM,

3.3 All expenses including boarding, lodging, transport, etc., of the inspecting officials shall be borne by the contractor.

3.4 Upon successful completion of hardware inspection, Employer will issue delivery instruction to the contractor.

3.5 Transportation: The Contractor shall at its own risk and expense transport all the hardware to DAS control center by the mode of transport that the Contractor judges most suitable under all the circumstances.

Contractor shall be responsible for obtaining, if necessary, approvals from the authorities for transportation of hardware to the Site. The Employer shall use its best endeavors in a timely and expeditious

manner to assist the Contractor in obtaining such approvals, if requested by the Contractor. The Contractor shall indemnify and hold harmless the Employer from and against any claim for damage to roads, bridges or any other traffic facilities that may be caused by the transport of the Plant and Equipment and the Contractor's Equipment to the Site.

3.6 All documents like e-way bill, BOQ list, delivery challan, etc. listed in the price schedule shall be submitted by the contractor for Employer review.

4. Hardware installation

4.1 Unless otherwise expressly limited in the Technical Specifications, the Contractor's obligations cover the provision of all hardware, performance of all Installation Services required for design, manufacture, procurement, quality assurance, construction, installation, associated civil works, pre-commissioning and delivery of hardware and completion of Facilities in accordance with the plans, procedures, specifications, drawings, codes and any other documents as specified in the Technical Specifications. Contractor is responsible for the following, but not limited to, supervision and engineering services, supply of skilled labor, materials, equipment, spare parts and accessories, Contractor's Equipment; construction utilities and supplies, temporary materials, structures and facilities, transportation (including, without limitation, unloading and hauling to, from and at the Site) and storage.

4.2 Contractor shall, unless specifically excluded in the Contract, perform all such work and/or supply all such items and materials not specifically mentioned in the Contract but that can be reasonably inferred from the Contract as being required for commissioning the hardware, as if such work and/or items and materials were expressly mentioned in the Contract.

4.3 Contractor shall provide and maintain at its own expense all lighting, fencing, and watching when and where necessary for the proper execution and the protection of the Facilities, or for the safety of the owners and occupiers of adjacent property and for the safety of people working at DAS control center.

4.4 Contractor's Supervision: Contractor shall give or provide all necessary superintendence during the installation of the Facilities, and the Construction Manager or its deputy shall be constantly on the Site to provide full-time superintendence of the installation. The Contractor shall provide and employ only technical personnel who are skilled and experienced in their respective callings and supervisory staff who are competent to adequately supervise the work at hand. Contractor shall engage subject matter experts from the OEM of the hardware during installation and commissioning of corresponding hardware to expedite the activity.

4.5 Contractor shall be responsible for the recruitment, transportation, accommodation and catering of all labor, local or expatriate, required for the execution of the Contract and for all payments in connection therewith.

4.6 Contractor shall at all times during the progress of the Contract use its best endeavors to prevent any unlawful, riotous or disorderly conduct or behavior by or amongst its employees and the labor.

4.7 No work shall be carried out during the night and on public holidays of the country where the Site is located without prior written consent of the Employer, except where work is necessary or required to ensure safety of the Facilities or for the protection of life, or to prevent loss or damage to property, when the Contractor shall immediately advise the Employer's Representative. If and when the Contractor considers it necessary to carry out work at night or on public holidays so as to meet the Time for Completion and requests the Employer's consent thereto, the Employer shall not unreasonably withhold such consent.

4.8 Contractor's Equipment: All Contractor's Equipment brought by the Contractor onto the Site shall be deemed to be intended to be used exclusively for the execution of the Contract. The Contractor shall not remove the same from the Site without the Employer's Representative's consent that such Contractor's Equipment is no longer required for the execution of the Contract. Upon completion of the Facilities, the Contractor shall remove from the Site all Contractor's Equipment brought by the Contractor onto the Site and any surplus materials remaining thereon.

4.9 Bench Mark: Contractor shall be responsible for the true and proper setting-out of the Facilities in relation to bench marks, reference marks and lines provided to it in writing by or on behalf of the Employer. If, at any time during the progress of installation of the Facilities, any error shall appear in the position, level or alignment of the Facilities, the Contractor shall forthwith notify the Employer's Representative of such error and, at its own expense, immediately rectify such error to the reasonable satisfaction of the Employer's Representative.

4.10 Site Clearance: Site Clearance in Course of Performance: In the course of carrying out the Contract, the Contractor shall keep the Site reasonably free from all unnecessary obstruction, store or remove any surplus materials, clear away any wreckage, rubbish or temporary works from the Site, and remove any Contractor's Equipment no longer required for execution of the Contract. Clearance of Site after Completion: After Completion of all parts of the Facilities, the Contractor shall clear away and remove all wreckage, rubbish and debris of any kind from the Site, and shall leave the Site and Facilities clean and safe.

4.11 The contractor shall establish the communication link from DAS control centers to the remote VDU locations in BESCOM's Zonal and Circle offices. This communication link will terminate at the SD-WAN device thus connecting the Remote VDU workstation to DAS system.

5. Integration with DAS system and Commissioning

5.1 As soon as the delivered hardware, in the opinion of the Contractor, have been installed operationally and structurally and put in a tight and clean condition as specified in the Technical Specifications, the contractor shall integrate the hardware, SMS gateway, video projection system, etc with DAS system in consultation with the Employer.

5.2 As soon as all works in respect of integration are completed and, in the opinion of the Contractor, the Facilities or any part thereof is ready for Commissioning, the Contractor shall submit Site Acceptance test procedures for Employer review and approval.

5.3 The contractor shall engage OEM representatives to provide training to Employer representatives regarding workstation maintenance, SMS gateway and VPS.

5.4 After completion of training, the contractor shall notify the Employer's Representative in writing regarding commencement of SAT.

5.5 The Contractor's personnel shall attend, advice and assist the Employer throughout SAT activity

5.6 Upon successful completion of SAT, the hardware delivered under this contract shall be declared as commissioned by the Employer and issue Operational Acceptance certificate, indicating the commencement of Defect Liability Period.

6. Defect Liability

6.1 The Contractor warrants that the Facilities or hardware commissioned shall be free from defects in design, engineering, materials and workmanship of the Plant and Equipment supplied and of the work executed.

6.2 Defect Liability Period, i.e., the warranty period, shall be five years from the date of Operational Acceptance of the Facilities.

6.3 If during the Defect Liability Period any defect should be found in the design, engineering, materials and workmanship of the Plant and Equipment supplied or of the work executed by the Contractor, the Contractor shall promptly, in consultation and agreement with the Employer regarding appropriate remedying of the defects, and at its cost, repair, replace or otherwise make good (as the Contractor shall, at its discretion, determine) such defect as well as any damage to the Facilities caused by such defect. The Contractor shall not be responsible for the repair, replacement or making good of any defect or of any damage to the Facilities arising out of or resulting from any of the following causes:

(a) improper operation or maintenance of the Facilities by the Employer

(b) operation of the Facilities outside specifications provided in the Contract

(c) normal wear and tear.

6.4 Contractor's obligations under this Clause shall not apply to any materials that are supplied by the Employer and/or are normally consumed in operation,

6.5 Employer shall give the Contractor a notice stating the nature of any such defect together with all available evidence thereof, promptly following the discovery thereof. The Employer shall afford all reasonable opportunity for the Contractor to inspect any such defect.

6.6 Employer shall afford the Contractor all necessary access to the Facilities and the Site to enable the Contractor to perform its obligations under this Clause .The Contractor may, with the consent of the Employer, remove from the Site any Plant and Equipment or any part of the Facilities that are defective if the nature of the defect,

and/or any damage to the Facilities caused by the defect, is such that repairs cannot be expeditiously carried out at the Site.

6.7 If the repair, replacement or making good is of such a character that it may affect the efficiency of the Facilities or any part thereof, the Employer may give to the Contractor a notice requiring that tests of the defective part of the Facilities shall be made by the Contractor immediately upon completion of such remedial work, whereupon the Contractor shall carry out such tests.

If such part fails the tests, the Contractor shall carry out further repair, replacement or making good (as the case may be) until that part of the Facilities passes such tests. The tests shall be agreed upon by the Employer and the Contractor.

6.8 If the Facilities or any part thereof cannot be used by reason of such defect and/or making good of such defect, the Defect Liability Period of the Facilities or such part, as the case may be, shall be extended by a period equal to the period during which the Facilities or such part cannot be used by the Employer because of any of the aforesaid reasons.

6.9 If a Facility, or any part thereof, or the process performed thereby should require correction during the Default Liability period, the Employer shall have the right to use such Facility, or part thereof, until such time as it is convenient to the Employer for the Facility, or part thereof, to be removed from service for correction. Such use shall not constitute acceptance nor shall it constitute a waiver of any of the Employer's rights under the Contract Agreement.

6.10 There shall be no restrictions on the Employer's rights to use, modify, expand, add to, or in any way adapt a Facility or any portion of it to best suit the Employer's needs as determined by the Employer at any time following the end of the Defects Liability Period. Any changes to be made by and in convenience of the Employer during the defects liability period, and the possible impact on warranty, will be

mutually agreed in advance. The Employer has the further right to use the Facility with or without additions for purposes not envisioned at the execution of the Contract Agreement and not described therein. These rights shall survive the Contract Agreement.

7. Bill of quantities

Contractor shall note that the items and their quantities listed below are tentative. Any additional material or software license that will be required during execution of work shall be delivered by the contractor at no additional cost to BESCOM.

Sl. No.	Description	Unit	Qty
1	Workstation with dual Monitors for Network monitoring as per technical specification defined in tender	Set	6
2	Operations Department Interface console with single monitor as per technical specification defined in tender	Set	2
3	Remote VDUs with single monitor at Zonal and Circle offices as per technical specification defined in tender	Set	6
4	Firewall /SD-WAN at Remote VDU location as per technical specification defined in tender	No.	6
5	Video Projection system including video wall and video wall processor/controller as per technical specification defined in tender	Set.	1

6	L-2 Managed Switch - 16 port that supports 10/100/1000 Mbps Gigabit Ethernet ports, SFP compatible ports, SNMP, VLANs for network segmentation as per technical specification defined in tender	No.	4
7	DAC Simulator Laptops as per technical specification defined in tender	No.	8
8	SMS gateway - hardware, software and integration with DAS control centers as per technical specification defined in tender	Set	2
9	Time, day & date digital display at BICC-1 as per technical specification defined in tender	Set	1
10	Color multifunction printer supporting A3 and A4 as per technical specification defined in tender	No.	2
11	Black and White multifunction printer supporting A3 and A4 as per technical specification defined in tender	No.	2
12	Cables, ducts, trays and Installation Materials for Networking and Electrical cabling at control center and Remote VDU locations as per technical specification defined in tender	Lot	2